

Attorney Docket No. 2003B005/2

AMENDMENTS TO THE DETAILED DESCRIPTIONRECEIVED
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Please amend the specification as follows:

Please replace paragraph [0004] beginning on page 2, line 1 of the application as written with the following replacement paragraph:

An ongoing need exists for processes that provide propylene copolymers with suitable functionality, good processability and high melt strength, which are desirable for applications such as radiation resistance, paintability, dyeability, functionalization, adhesion, compatibility, thermoforming, foaming, and blow molding. Poor melt strength of polypropylenes shows up as excess sag in sheet extrusion, rapid thinning of walls in parts thermoformed in the melt phase, low draw-down ratios in extrusion coating, poor bubble formation in extrusion foam materials, and relative weakness in large-part blow molding. The [[PP]] polypropylene homopolymer as such is deficient in radiation resistance, adhesion, paintability, compatibility that preclude its use in many end-use applications. Thus, it would be highly desirable to produce a polypropylene having olefinic functionality, enhanced melt strength and commercially valuable processability.

Please replace paragraph [0007] beginning on page 2, line 21 of the application as written with the following replacement paragraph:

Described below are processes of preparing a copolymer composition that includes a diene-modified polypropylene random copolymer, which processes include: contacting a metallocene catalyst compound with a polymerization medium that includes at least a propylene monomer and 2-methyl-1,5-hexadiene or an α , internal non-conjugated diene monomer; and conducting polymerization of the monomers in the presence of the metallocene catalyst compound for a time sufficient to provide a diene-modified polypropylene random copolymer that includes monomeric units derived from each of the monomers, and having from 0.0 wt% to 2.0 wt% ethylene and a heat of fusion of 25 J/g or more, or 30 J/g or more.

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Please replace paragraph [0008] beginning on page 3, line 1 of the application as written with the following replacement paragraph:

Also described are processes of preparing a polymer composition that includes a diene-modified polypropylene random copolymer, which processes preferably include: contacting a metallocene catalyst compound having at least two indenyl rings or derivatives of indenyl rings, each ring being substituted at the 2 and/or 4 positions, with a polymerization medium that includes at least a propylene monomer and 2-methyl-1,5-hexadiene or an α , internal non-conjugated diene monomer that has an internal double bond comprising a di-substituted vinyl group or a tri-substituted vinyl group; and conducting polymerization of the monomers in the presence of the metallocene catalyst compound for a time sufficient to provide a diene-modified polypropylene random copolymer that includes monomeric units derived from each of the monomers, and having from 0.0 wt% to 2.0 wt% ethylene and a heat of fusion of 25 J/g or more, or 30 J/g or more.

Please replace paragraph [0009] beginning on page 3, line 13 of the application as written with the following replacement paragraph:

Also described are polymer compositions that include a diene-modified polypropylene random copolymer having propylene units; 2-methyl-1,5-hexadiene derived units or diene units derived from α , internal non-conjugated diene monomers; from 0.0 wt% to [[20]] 2.0 wt% ethylene units; and a heat of fusion of 25 J/g or more, or 30 J/g or more.

Please replace paragraph [0017] beginning on page 5, line 8 of the application as written with the following replacement paragraph:

The term "diene" is defined as a hydrocarbon compound that has two unsaturation sites, i.e., a compound having two double bonds connecting carbon atoms.[[.]] Depending on the context, the term "diene monomer" in this patent refers broadly to either a diene monomer prior to polymerization, e.g., forming part of the polymerization medium, or a diene monomer after polymerization has begun (also referred to as a diene monomer unit or a diene monomeric unit).

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Please replace paragraph [0018] beginning on page 5, line 15 of the application as written with the following replacement paragraph:

The term "non-conjugated diene" refers to a diene that is not "conjugated," meaning that at least one of the carbon atoms in the [[polymer]] monomer backbone has single bonds but no double or triple bond. Thus, any butadiene is not considered herein to be a "non-conjugated diene[["]]."

Please replace paragraph [0019] beginning on page 5, line 19 of the application as written with the following replacement paragraph:

The term "internal diene" refers to a diene in which at least one of the double bonds is not at the end of the polymer chain monomer unit structure.

Please replace paragraph [0021] beginning on page 5, line 25 of the application as written with the following replacement paragraph:

The term " α , internal[[,]] non-conjugated diene" is an α , internal diene that is nonconjugated, meaning that at least one of the carbon atoms in the [[polymer]] monomer backbone of the α , internal diene has single bonds but no double or triple bond.

Please replace paragraph [0044] beginning on page 11, line 15 of the application as written with the following replacement paragraph:

Certain specific embodiments of the invention will now be discussed. For example, a process of preparing a copolymer composition that includes a crosslinkable diene-modified polypropylene random copolymer is described, which process includes: contacting a metallocene catalyst compound with a polymerization medium that includes at least a propylene monomer and 2-methyl-1,5-hexadiene monomer or an α , internal non-conjugated diene monomer; and conducting polymerization of the monomers in the presence of the metallocene catalyst compound for a time sufficient to provide a diene-modified polypropylene random copolymer that includes monomeric units derived from each of the

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monomers, and having from 0.0 wt% to 2.0 wt% ethylene and a heat of fusion of 25 [[J/b]] J/g or more, or 30 J/g or more, 50 J/g or more, or 70 J/g or more in some embodiments.

Please replace paragraph [0045] beginning on page 11, line 26 of the application as written with the following replacement paragraph:

Also described are processes of preparing a polymer composition that includes a diene-modified polypropylene random copolymer, which processes preferably include: contacting a metallocene catalyst compound having at least two indenyl rings or derivatives of indenyl rings, each ring being substituted at the 2 and/or 4 positions, with a polymerization medium that includes at least a propylene monomer and 2-methyl-1,5-hexadiene monomer or an α , internal non-conjugated diene monomer that has an internal double bond comprising a di-substituted vinyl group or a tri-substituted vinyl group; and conducting polymerization of the monomers in the presence of the metallocene catalyst compound for a time sufficient to provide a diene-modified polypropylene random copolymer that includes monomeric units derived from each of the monomers, and having from 0.0 wt% to 2.0 wt% ethylene and a heat of fusion of 30 J/g or more, and a Branching Index of 1.0 or less, 0.95 or less, 0.90 or less or 0.80 or less.

Please replace paragraph [0049] beginning on page 12, line 18 of the application as written with the following replacement paragraph:

In one or more of the processes described herein the diene is 2-methyl-1,5-hexadiene or an[[, the]] α , internal non-conjugated diene monomer, can include 2-methyl-1,5-hexadiene or such as 7-methyl-1,6-octadiene.

Please replace paragraph [0063] beginning on page 20, line 1 of the application as written with the following replacement paragraph:

In one or more embodiments described herein, the propylene copolymers have a Branching Index of 1.0 or less, or 0.98 or less, or [[.95]] 0.95 or less, or 0.90 or less, or 0.80 or less.

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Please replace paragraph [0064] beginning on page 20, line 5 of the application as written with the following replacement paragraph:

As mentioned above, certain embodiments of this invention relate to a copolymer composition. In one or more specific embodiments, this invention is directed to a copolymer composition that includes crosslinkable diene-modified polypropylene random copolymer having propylene units; 2-methyl-1,5-hexadiene derived units or diene units derived from α , internal non-conjugated diene monomers; from 0.0 wt% to [[20]] 2.0 wt% ethylene units; and a heat of fusion of 25 J/g or more or 30 J/g or more.

Please replace paragraph [0065] beginning on page 20, line 11 of the application as written with the following replacement paragraph:

In one or more of the polymer compositions described herein, the diene units derived from 2-methyl-1,5-hexadiene monomers or α , internal non-conjugated diene monomers are present in the polypropylene copolymer in an amount of from 0.0005 mol% to 10 mol% or, in another specific embodiment, from 0.005 mol% to 1 mol%.

Please replace paragraph [0066] beginning on page 20, line 15 of the application as written with the following replacement paragraph:

In one or more of the polymer compositions described herein, the diene monomer is 2-methyl-1,5-hexadiene or the α , internal non-conjugated diene monomer is selected from the group consisting of 2-methyl-1,5-hexadiene and 7-methyl-1,6-octadiene 7-methyl-1,6-octadiene.

Please replace paragraph [0067] beginning on page 20, line 18 of the application as written with the following replacement paragraph:

In one or more of the polymer compositions described herein, the propylene copolymer has a crystallization temperature (Tc) of 25 °C or more. Alternatively, the

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polypropylene copolymer has a crystallization temperature (Tc) of 50 °C or more; or a crystallization temperature (Tc) of 75 °C or more; or a crystallization temperature (Tc) of 100 °C or more; or a crystallization temperature (Tc) of 125 °C or more; or a crystallization temperature (Tc) ranging from 25 °C to 115 °C.

Please replace paragraph [0070] beginning on page 21, line 4 of the application as written with the following replacement paragraph:

Embodiments of the invention include combining in a polymerization zone (a) propylene monomers; (b) 2-methyl-1,5-hexadiene monomers and/or one or more alpha, internal non-conjugated diene monomers (also referred to as α , internal non-conjugated diene monomers or AIN dienes); and (c) a metallocene catalyst system under suitable polymerization conditions to produce a cross-linkable polypropylene random copolymer composition.

Please replace paragraph [0072] beginning on page 21, line 16 of the application as written with the following replacement paragraph:

The α , internal diene monomers may be linear, cyclic, and/or multicyclic, including fused and non-fused cyclic dienes. Preferably, the α , internal diene monomers are non-conjugated and linear. Also[[,]] preferably, the α , internal diene monomers include α , internal non-conjugated dienes in which the internal double bond is a vinylidene group or a tri-substituted unsaturation site. Examples of preferred α , internal non-conjugated dienes include 2-methyl-1,5-hexadiene (which has a vinylidene group); 7-methyl-1,6-octadiene (which has a tri-substituted unsaturation site); dicyclopentadiene vinylnorbornene; ethyldiene norbornene; 4-vinylcyclohexene; and 4-vinyl cyclopentene. Alternatively, 2-methyl-1,5-hexadiene (which has a vinylidene group) can be used.

Please replace paragraph [0076] beginning on page 22, line 10 of the application as written with the following replacement paragraph:

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It is further contemplated that the diene monomers, 2-methyl-1,5-hexadiene and/or the α, internal non-conjugated diene monomers, form side chain unsaturation sites in the polypropylene main chain. It is contemplated that the α-double bond of the α, internal non-conjugated diene monomers is polymerized by the metallocene catalyst system at a rate comparable with propylene polymerization while the internal bond of the α, internal non-conjugated diene monomers is incapable, or less capable, of polymerization by the metallocene catalyst system at a rate comparable with the propylene polymerizations. It is further contemplated that the substituents of the internal double bond sterically hinder polymerization by the metallocene catalyst of the internal double bond. Preferably, the side chain unsaturation sites enable the polymer to be cross-linked through exposure to radiation, heat, or cross-linking agents (i.e., peroxides[[.]]). Cross-linking of the polymer through the side chain unsaturation sites derived from α, internal non-conjugated dienes provides H-type branching.

Please replace paragraph [00135] beginning on page 84, line 10 of the application as written with the following replacement paragraph:

At the reactor outlet valve the pressure drops to begin the separation of polymer and unreacted monomer, co-monomers, propane, etc. The temperature in this vessel is typically maintained above the polymer product's crystallization point but the pressure may be below the critical point. The pressure need only be high enough that the propylene can be condensed against standard cooling water. The liquid recycle stream can then be recycled to the reactor with a liquid pumping system instead of the hyper-compressors required for [[Polyethylene]] Polyethylene units. The relatively low pressure in this separator will reduce the monomer concentration in the liquid polymer phase which will result in a much lower polymerization rate. This polymerization rate may be low enough to operate this system without adding a catalyst poison or "killer[[.]]." If no poison is added to the system then the recycle stream will not require treating before it can be fed back to the reactors. If, however, a catalyst killer is required (e.g., to prevent reactions in the high pressure recycle) then provision is preferably made to remove any potential catalyst poisons from the recycled propylene rich monomer stream, e.g., by the use of fixed bed absorbents or by scavenging with an aluminum alkyl.

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Please replace paragraph [00136] beginning on page 84, line 27 of the application as written with the following replacement paragraph:

Alternatively, the HPS may be operated over propylene's critical pressure but within the propylene/polypropylene two phase region. This is an economically preferred method if polypropylene is to be produced with a revamped high pressure polyethylene ("HPPE") plant. The recycled HPS overhead is cooled and dewaxed before being returned to the suction of the secondary compressor, which is typical of HPPE plant operation.

Please replace paragraph [00139] beginning on page 85, line 10 of the application as written with the following replacement paragraph:

Industrially a loop reactor is not operated at the high pressures encountered in autoclaves and tubes. One version of the [[PP]] polypropylene process operates in a supercritical region but below the cloud point curve of the polymer and at temperatures below the polymer crystallization point. Thus the polymer is present as a slurry with the temperature below the melting point of the polymer to avoid fouling deposition of polymer on the wall thereby reducing heat exchange.

Please replace paragraph [00144] beginning on page 86, line 4 of the application as written with the following replacement paragraph:

Propylene and higher olefins are far less susceptible to temperature runaway and explosive decomposition than ethylene, so potentially a higher maximum reactor operating temperature can be tolerated but within the limits of catalyst activity, molecular weight and [[isotacticity]] isotacticity requirements of the products.

Please replace paragraph [00153] beginning on page 87, line 30 of the application as written with the following replacement paragraph:

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The low pressure separator ("LPS") running at just above atmospheric pressure is a sub critical flash of light components, reactants and oligomers thereof, for the purpose of producing a low volatile containing polymer melt entering the finishing extruder or static mixer.

Please replace paragraph [00166] beginning on page 91, line 24 of the application as written with the following replacement paragraph:

The films described herein may also comprise from 5 to 60 weight %, based upon the weight of the polymer and the resin, of the hydrocarbon resin. The resin may be combined with the polymer of the seal layer(s) or may be combined with the polymer in the core layer(s). The resin preferably has a softening point above 100 °C[.], even more preferably from 130 °C to 180 °C. Preferred hydrocarbon resins include those described above. The films comprising a hydrocarbon resin may be oriented in uniaxial or biaxial directions to the same or different degrees.

Please replace paragraph [00186] beginning on page 99, line 2 of the application as written with the following replacement paragraph:

In this example, a number of copolymers were synthesized using specific metallocene catalysts via batch bulk propylene slurry processes. The comonomers used in the polymerization were: 7-methyl-1,6-octadiene (MOD); 2-methyl-1,5-hexadiene (MHD);. The specific catalysts used were supported dimethylsilylbis(2-methyl-4-phenyl indenyl)zirconium dichloride and supported dimethylsilylbis (2-methylyindenyl)zirconium dichloride/MAO. Individual batch copolymerization runs were conducted using one of the above comonomers and catalysts @ 60 – 70[°] °C for 30 - 60 minutes under hydrogen (0 - 6 psi). The products were washed twice with hexane to remove the residual comonomer and were characterized by ¹H NMR, DSC, MI, and GPC-3D techniques. The copolymerization conditions and results are included in Tables 4-10.

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Please amend the Abstract as follows:

Please replace the paragraph beginning on page 116 of the application as written with the following replacement paragraph:

Certain specific embodiments of the invention will now be discussed. For example, a process of preparing a copolymer composition that includes a diene-modified polypropylene copolymer is described, which process includes: contacting a metallocene catalyst compound with a polymerization medium that includes at least a propylene monomer and 2-methyl-1,5-hexadiene monomer or an α, internal non-conjugated diene monomer; and conducting polymerization of the monomers in the presence of the metallocene catalyst compound for a time sufficient to provide a diene-modified polypropylene random copolymer that includes monomeric units derived from each of the monomers, and having from 0.0 wt% to 2.0 wt% ethylene and a heat of fusion of 25 J/g or more.